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***Announcement of Courses in***  
**WAR TRAINING *for***  
**ILLINOIS INDUSTRIES**

**Conducted by**  
**UNIVERSITY OF ILLINOIS**  
**Division of University Extension**  
**URBANA, ILLINOIS**

**IN COOPERATION WITH**  
**Engineering Science and Management War Training Program**





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## FOREWORD

To Prospective Students:

More than 27,000 persons in Illinois, both men and women, have studied in the courses conducted thus far in the Engineering, Science, and Management Training Program administered by the University of Illinois. These people have done so in part because of a desire to improve and to upgrade themselves, but in part, also, because of their desire to increase their usefulness to the nation in the all-out war effort. It is most heartening to observe their response to these opportunities presented to them, and to see the eagerness and earnestness with which they go about their studies.

Those of us on the administrative staff of the Division of University Extension of the University of Illinois are grateful to all who participate, for their generous willingness to put time and energy into this important part of the battle on the home front. We welcome the new students now joining the classes, and extend greetings to all students already enrolled, who continue in additional classes.

ROBERT B. BROWNE, Director  
Division of University Extension

H. C. ROUNTREE, Supervisor  
Extension in Engineering

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## **GENERAL ANNOUNCEMENT**

This announcement is only a partial list of the courses offered by the Division of University Extension of the University of Illinois in cooperation with the United States Office of Education. The list of courses contained herein is based on the results of an industrial survey of the war industries in your local community. New courses will be added from time to time as the need arises. The War Training Program was established to provide college level training in essential fields for both men and women, whose effectiveness in the war effort can be increased through training in short, intensive courses. No college credit is given, and there is no enrollment or tuition fee. The only expenses to be met by the students are the cost of the textbook and similar materials.

### **Time and Place of Instruction**

The program has been designed to serve the training needs of the War Industries. Classes may be scheduled to meet any time of the day or evening. The needs of a single industry, or of a number of industries in a community, will determine the time and place of class meetings. Additional information may be obtained by writing to H. C. ROUNTREE, Division of University Extension, University of Illinois, Urbana, Illinois.

### **Certificates**

Certificates will be awarded to those students who complete a course satisfactorily.



# INDUSTRIAL ACCOUNTING I

**OBJECTIVE.**—To train accountants for war industries which produce or handle war supplies and materials. This course should enable those individuals who have recently assumed accounting positions in war industries to fulfill their duties more adequately, and should facilitate their ability to adapt themselves to new functions and duties.

**PREREQUISITE.**—High school graduation with one year of bookkeeping or its equivalent in training and experience. Employed in accounting work in war industry, and recommended by management to take this course.

**COURSE CONTENT.**—A study of the transactions and phases of accounting with which an employee of an accounting department of a war industry must be familiar. Covers the complete accounting cycle including journalizing, use of columnar books, posting, trial balances, adjusting entries, financial statements, and closing. Also includes partnership and corporation accounting, negotiable instruments, bank reconciliations, auxiliary records, business forms and procedures, sales and collection transactions, and distribution of incomes and expenses by departments. A practice set of books is kept which will give students practical training in business procedures, use of business papers, and application of accounting principles.

Total hours 96;—2 nights per week; 3 hours per night.



## INDUSTRIAL ACCOUNTING II

### (Advanced)

**OBJECTIVE.** — To provide advanced accounting training for those individuals who hold responsible accounting positions in war industries and to aid those individuals with insufficient accounting training, to extend their present knowledge so that they will be equipped to assume more responsible positions.

**PREREQUISITE.** — High school graduation or equivalent education, and completion of Industrial Accounting I, or equivalent, college accounting training, and employment in war industry for which this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — A study of advanced general accounting principles and practices, with emphasis upon advanced corporation accounting. The material presented covers such topics as single entry accounting and conversion to a double entry basis, analysis of financial statements, forfeited stock subscriptions, watered stock, trusts, earned and capital surplus, dividends, and other advanced corporation accounting topics, analysis of accounts receivable, retail method of pricing inventories, installment sales, fixed assets, depreciation methods, funds and reserves, correction of statements and books, and statement of application of funds.

Total hours 72;—2 nights per week; 3 hours per night.



# INDUSTRIAL COST ACCOUNTING

**OBJECTIVE.**— To train individuals for immediate employment as cost clerks, cost accountants, or accounting department employees in concerns manufacturing war supplies, or to give persons now engaged in accounting work in war industries the opportunity to increase their knowledge of cost accounting and to secure training for more responsible positions.

**PREREQUISITE.**— High school graduation and one year of general college accounting or two years of high school bookkeeping or completion of the ESMWT course in Industrial Accounting I or II. Employment in war industry and recommendation by management.

**COURSE CONTENT.**— A study of the principles and objectives of cost accounting and of the accounting problems peculiar to manufacturing enterprises. The course begins with a study of departmental accounting for a trading concern and then treats in logical sequence such topics as general accounting for the factory, parallel and sequential process cost accounting, job-lot accounting, manufacturing statements, books of original entry peculiar to manufacturing concerns, accounting for materials, supplies, labor, and burden, and departmental cost accounting.

Total hours 72;—2 nights per week; 3 hours per night.





# **COST STANDARDS FOR INDUSTRIAL CONTROL**

**OBJECTIVE.** — To provide war industries with competent cost accountants, cost clerks, accounting clerks, and better accounting management. To train cost accountants in war industries for more responsible positions and to enable them to advance the war effort in their respective industries.

**PREREQUISITE.** — High school graduation with a knowledge of accounting and cost accounting and employment in accounting work of war industry.

**COURSE CONTENT.** — A study of manufacturing and advanced cost accounting problems, with emphasis upon standard costs and the use of accounting for better management. The material presented analyzes the methods of deriving and presenting cost data intended to show how much of the total expenditure resulted in waste, and to furnish management with information for control purposes. The course covers such topics as expense distribution by the double-base method, the flexible budget, burden application, differential costs, the effect of volume on profits, the use of standard costs, analysis of variations from standards, accounting for hedging, accounting for by-products and joint products, and interest as a cost of manufacturing.

Total hours 72 ;—2 nights per week ; 3 hours per night.



# **MANAGERIAL ACCOUNTING AND PRODUCTION PROCEDURES (In Service)**

**OBJECTIVE.** — To provide training for supervisors and accounting personnel in war industries in the fundamentals of industrial accounting, cost accounting and standard costs; and to coordinate the production and accounting procedures of operating and accounting control.

**PREREQUISITE.** — High school graduation or equivalent in appropriate experience, and a working knowledge of basic accounting. Responsible position in Production Department or Accounting Department of a war industry and satisfactory interview with instructor.

**COURSE CONTENT.** — A study of the principles and procedures of general and cost accounting and cost standards. This course begins with the fundamentals of general accounting and of cost accounting, and then covers the application of these principles to a manufacturing concern and the procedures followed in the collection, tabulation, summarizing and interpreting of data relating to accounting and production control. It also covers financial statements, books of original entry, ledger controls, burden application, standard costs, and problems of depreciation, depletion, and amortization.

Total hours 64;—2 nights per week; 2 hours per night.



# **ENGINEERING CHEMISTRY— INORGANIC I (In Service)**

**OBJECTIVE.** — To provide an understanding of chemical principles and changes particularly as they relate to engineering work. This course will serve as a basis for further study in the field of chemistry.

**PREREQUISITE.** — High school graduation with one year of chemistry or equivalent in practical experience in a chemical laboratory, and employment in war work where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — A course of this type of elementary chemistry must of necessity include a detailed consideration of basic chemical theory and principles. This course will begin, therefore, with material dealing with the theory of matter and its application in the study of certain important non-metals, such as oxygen, hydrogen, etc. Instruction will be given by means of lectures and laboratories, wherein the lecture material will be supplemented by appropriate experiments.

Total hours 72;—2 nights per week; 3 hours per night.





# ENGINEERING CHEMISTRY— INORGANIC II

**OBJECTIVE.**—To provide further basic work necessary to the understanding of chemical changes involved in inorganic chemistry, to give instruction in the nature of important engineering materials, such as steel, cement and glass, and to provide an understanding of such industrial practices as water softening and the refining of metals. This course serves as a basis for Engineering Chemistry—Analytical.

**PREREQUISITE.**—High school graduation with one year of chemistry or equivalent in practical experience in a chemical laboratory, or completion of Engineering Chemistry Inorganic I, and employment in war industry where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—This course is essentially a continuation of Inorganic Chemistry I, dealing particularly with the metallic elements. The preparation and utilization of the common metals and their salts will be discussed, with emphasis on applications to engineering. The effects of alloying and heat treating will be explained from the chemical point of view. The laboratory work is designed to give broad experience with the metals and their compounds.

Total hours 72 ;—2 nights per week ; 3 hours per night.



# ENGINEERING CHEMISTRY— ORGANIC

**OBJECTIVE.** — To provide training for those persons who are now employed in industries engaged in the production of war materials. This training is expected to be rather broad, and to give a general background, so that the employee may understand the organic reactions with which he deals in his work.

**PREREQUISITE.** — High school graduation or its equivalent in training. Completion of the course Inorganic Chemistry I or one semester of college chemistry is required, and employment in war work where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — The course will cover the chemistry of the more important compounds including hydrocarbons, alcohols, ethers, aldehydes, ketones, acids and their derivatives, esters, carbohydrates, and heterocyclics. Emphasis will be placed on recent industrial developments, and, in each community, on the organic chemistry involved in the local industries. The laboratory experiments exemplify the more important organic reactions and give experience in organic procedures, such as crystallization, distillation and determination of purity.

Total hours 96;—2 nights per week ; 3 hours per night.



# ENGINEERING CHEMISTRY— ANALYTICAL

**OBJECTIVE.** — To give the student a working knowledge of industrial analytical processes. The classroom work is designed not only to introduce students to chemical analysis, but to provide a theoretical background for those who have had practical experience. The laboratory work is intended to give instruction in such important analytical procedures as precipitation, filtration, weighing, and the preparation and standardization of solutions, and to acquaint the student with both qualitative and quantitative procedures for the common elements.

**PREREQUISITE.** — High school graduation or its equivalent in appropriate experience and satisfactory completion of Engineering Chemistry (Inorganic). Employed in war industry where this training is needed or reasonable assurance of such employment on completion of the course.

**COURSE CONTENT.** — This course covers both qualitative and quantitative inorganic analysis, including separation of the ions from each other and their estimation by volumetric and gravimetric methods. Qualitative detection of the anions and the Kjeldahl method for nitrogen are included. In the laboratory work, special attention is paid to the development of good techniques. The importance of accuracy and rapidity in analytical work is stressed.

Total hours 112;—2 nights per week; 3½ hours per night.



# ENGINEERING DRAFTING I

**OBJECTIVE.**—To train men and women who have had little or no drawing experience in the theory and practice of drafting, in order that they may take their place in our war industries as junior draftsmen, tracers, and junior designers.

**PREREQUISITE.**—High school graduation or its equivalent, including two years of mathematics and employment in war industries where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—This course begins with lettering practice and the reading of drawings. Training in reading of drawings is provided by requiring the student to make freehand orthographic sketches from pictorial drawings and freehand pictorial drawings from orthographic drawings. The use of instruments and the techniques of drafting are thoroughly covered. The uses of charts and diagrams are discussed and illustrated. The theory of orthographic projection and the making of two and three view drawings are so important that quite a lot of time is devoted to the subject. The use of auxiliary planes is explained and drawings are made requiring the use of auxiliary views. Various kinds of sections are discussed and drawn. The subject of dimensioning is thoroughly covered and applied to working drawings. Various kinds of fasteners are drawn and their uses explained. Finally complete detail drawings are prepared with the necessary limit dimensions to give mating parts the proper fit.

Total hours 72;—2 nights per week; 3 hours per night.





## ENGINEERING DRAFTING II

**OBJECTIVE.** — To train men and women who already have some knowledge of drafting so that they can do better and more complicated work as draftsmen, engineering aides, elementary designers, and tracers.

**PREREQUISITE.** — High school graduation including two years of mathematics or its equivalent in industrial experience and completion of Engineering Drafting I, or the equivalent and employment in war industries where this training is needed, or reasonable assurance of such employment upon completion of course.

**COURSE CONTENT.** — Registration in this course assumes considerable knowledge of drawing theory and technique. Therefore, all preliminary work such as lettering and use of instruments is omitted. The course begins with a short review of orthographic projection, two and three view drawings. Next comes the use of auxiliary planes to find true size of faces of objects and true angles between lines or faces on the objects. Various kinds of sections and their uses are explained and drawn. A thorough study of dimensioning precedes its application in the making of complete working drawings. The subjects of fasteners and shop terms and processes are also covered. Pictorial drawings in the form of isometric and oblique are made. Simple intersections are found. Finally complete detail and assembly drawings of a piece of machinery are made including the required limit dimensions for mating parts. Alternate assignments in topographical, architectural or structural drafting are allowed in place of the final detail and assembly for students who desire a little training in one of those fields.

Total hours 72;—2 nights per week; 3 hours per night.



# DESCRIPTIVE GEOMETRY

**OBJECTIVE.** — To train men and women in the theory and use of orthographic projection. To develop the ability to visualize space relations and represent them correctly on a drawing. To help to develop the ability to analyze a problem, evolve a logical method of solution and carry it through to a final solution.

**PREREQUISITE.** — High school graduation with two years of mathematics or the equivalent and satisfactory completion of Engineering Drafting I or the equivalent. Employment in war industry.

**COURSE CONTENT.** — This course covers the theory of projections; solution of theoretical and practical problems involving size, shape, and relative position of common geometrical magnitudes such as points, lines, planes, curved surfaces, and solids. Specifically it involves the finding of such things as true length of a line, true size of an area, angle between two lines, angle between two planes, distance from a point to a line, distance from a point to a plane, common perpendicular between two non-parallel, non-intersecting lines, intersections, developments of plane surfaces and of curved surfaces. These and other problems are solved by the use of auxiliary planes in all cases unless there is a distinct advantage in the use of inclined planes. All problems are printed so that the student wastes no time in layout work and can thereby devote all his energy to the actual solution of the problem.

Total hours 72;—2 nights per week; 3 hours per night.



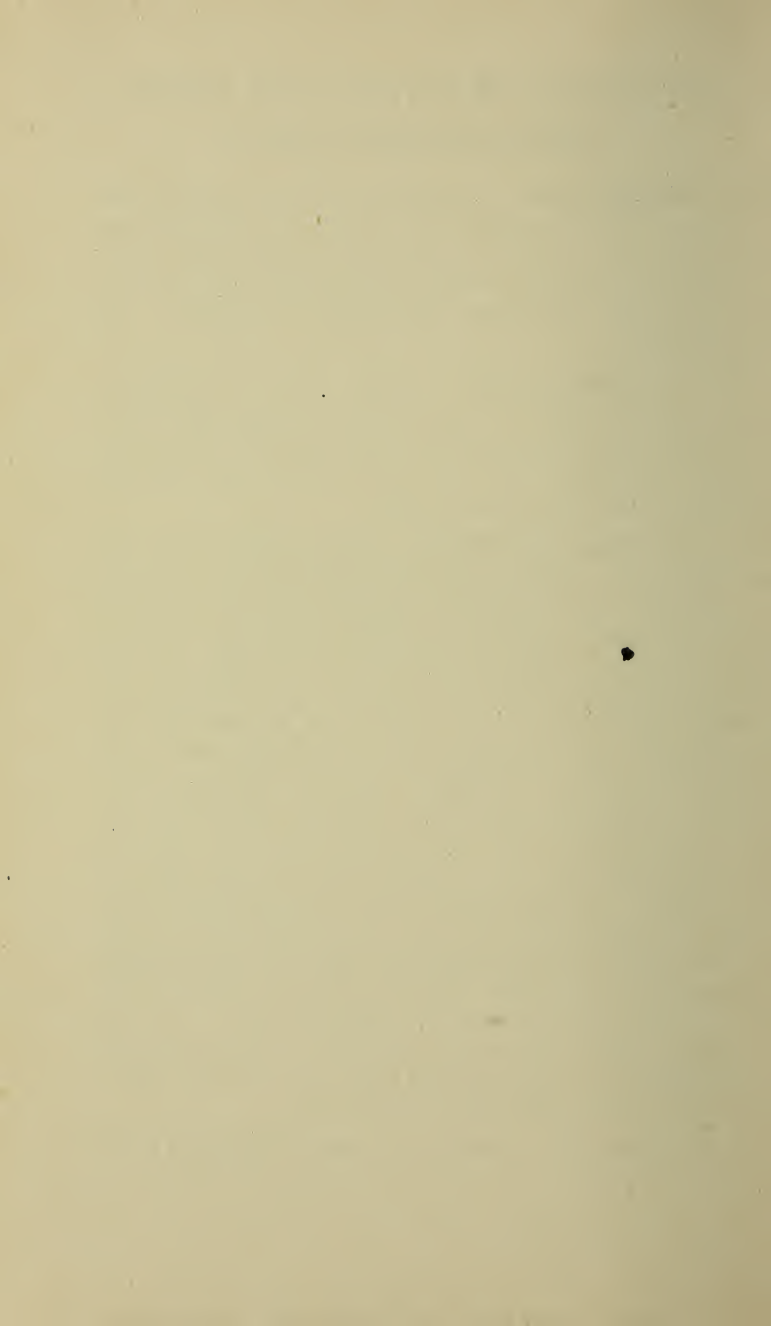
# PICTORIAL DRAFTING FOR INDUSTRIAL PRODUCTION I

**OBJECTIVE.** — To train men and women in the theory of axonometric and oblique drawing. To develop their ability to interpret orthographic drawings and to make freehand and mechanical pictorial drawings, including the proper technique and shading.

**PREREQUISITE.** — High school graduation with two years of mathematics or its equivalent and completion of course Engineering Drafting I, or its equivalent, and employment in war industry where this training is needed.

**COURSE CONTENT.** — This course covers the theory of making pictorial drawings and seeks to develop the technique to the point where the student can make acceptable drawings either mechanically or freehand. Various methods of shading a drawing are explained and enough practice is specified so that the shape of the object can be clearly portrayed. The following kinds of drawings are made by the student: isometric drawing, dimetric drawing, isometric projection, dimetric projection, trimetric projection and various kinds of oblique drawings such as cavalier, cabinet and general oblique. The isometric, dimetric and trimetric projections are done by a new easy method in which the pictorial is projected directly from the orthographic working drawings. Speed, accuracy, proper proportion and technique are emphasized in the freehand work. Practice is provided in the making of exploded or disassembled views of machines showing how they should be assembled.

Total hours 72;—2 nights per week; 3 hours per night.





# PICTORIAL DRAFTING FOR INDUSTRIAL PRODUCTION II

**OBJECTIVE.** — To give further practice in the making and use of axonometric and oblique drawings and to provide training in the theory and use of perspective projection including shades and shadows in perspective. To improve the student's technique in freehand work and in shading.

**PREREQUISITE.** — High school graduation with two years of mathematics or the equivalent and satisfactory completion of Pictorial Drafting for Industrial Production I, and employment in a war industry where this training is needed.

**COURSE CONTENT.** — This course provides a small amount of review of the theory covered in Pictorial Drafting for Industrial Production I, and further training in freehand drawing and shading. The greater part of the time is spent on theory of perspective and in making perspective drawings. The course covers the various methods of making perspective drawings, such as the visual ray method, vanishing point method, combination visual ray and vanishing point method and the measuring point method. Other phases of perspective are studied, including vanishing point of inclined lines, use of 45 degree lines, and shades and shadows in perspective. The use of perspective in drawing airplanes is developed and the production breakdown illustration is explained.

As a final problem the student is required to make a disassembled drawing of the various parts of a piece of equipment showing how the parts fit together. For this problem the student is required to make his own choice of the kind of projection to be used. The instructor's criticism of this work should help in developing the judgment of the student in the selection of the method of representing objects.

Total hours 72;—2 nights per week; 3 hours per night.



# ELEMENTS OF ELECTRICAL ENGINEERING

**OBJECTIVE.** — To provide training for those persons who are now employed in industries which are engaged in the production of war materials and supplies. The course has been prepared to provide instruction in the fundamental principles of electrical engineering and it is intended to be preparatory to the more advanced courses in the fields of power, communication, and electronics.

**PREREQUISITE.** — High school graduation with physics or equivalent, and employment in war work for which this training is needed, or reasonable assurance of such employment upon completion of training.

**COURSE CONTENT.** — Topics to be discussed include—sources of electrical power; characteristics of resistance, inductance and capacitance; Ohm's Law; solution of electrical circuit constants in series, in parallel and in series-parallel combinations; complex numbers; vector diagrams; and analysis of electrical circuits by use of complex numbers and vector diagrams. A review of mathematics as pertaining to the course material will be made at the beginning of the course and as needed during the course additional mathematical principles will be presented. Laboratory equipment is used to demonstrate the fundamental principles. After successfully completing this course of study, the individual should be qualified to continue in Electrical Circuits or any of the specialized courses in the fields of electronics or communications.

Total hours 72;—2 nights per week; 3 hours per night.



# **ELECTRIC AND MAGNETIC CIRCUIT ANALYSIS**

**OBJECTIVE.**—To provide training for those persons who are now employed in industries which are engaged in the production of war materials and supplies. The course provides instruction in the fundamental principles of electrical engineering and it is intended to be preparatory to the more advanced courses in this field of engineering.

**PREREQUISITE.**—High school graduation with two years of mathematics or equivalent in appropriate experience, and a working knowledge of electric circuit performance. Employment in war work where this training is needed.

**COURSE CONTENT.**—Topics to be discussed include: voltage generation; characteristics of resistance, inductance and capacitance; vectors and complex quantities; vector diagrams; power—single phase; polyphase circuits; power—polyphase; distribution circuits; magnetic circuits; magneto-motive force relationship.

Total hours 54;—1 night per week; 3 hours per night.



# **AIRCRAFT ELECTRICAL CIRCUITS AND EQUIPMENT**

## **(In Service Only)**

**OBJECTIVE.** — To provide training for those aircraft workers and Junior Engineers concerned with, and interested in, aircraft electrical systems.

**PREREQUISITE.** — High school graduation with one year of mathematics and physics, or equivalent in appropriate experience, and a working knowledge of electrical circuits and equipment used in the aircraft industry.

**COURSE CONTENT.** — This is a lecture and discussion course, covering the following topics: Power Plant Electrical Systems and Equipment, Electrical Motors and Drives, Lighting Systems and Controls, Electrical Bonding and Shielding, Radio Circuit Controls, and Instruments and Indicators.

Total hours 64;—2 nights per week; 2 hours per night.





# ELECTRICAL CIRCUITS

**OBJECTIVE.** — To provide training in the field of Electrical Engineering for men now employed in industries which are engaged in the production and processing of essentials for the war effort. This course has been designed to assist those men who desire to extend the knowledge of Electrical Circuit Theory and Application. Also, this course will be of great benefit to those individuals who are definitely interested in power transmission and distribution as well as those in the engineering departments of war industries, who are in direct contact with motor repair and control circuit maintenance.

**PREREQUISITE.** — High school graduation with two years of mathematics or its equivalent in experience and training. A knowledge of the course material in either "Elements of Electrical Engineering," "Electric and Magnetic Circuit Analysis," or "Aircraft Electric Circuits and Equipment" is essential; and employment in war work for which this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — The material presented in this course will give a working knowledge of direct current, single phase, and polyphase alternating current circuits. This includes the determination of circuit parameters, power factor, reactive volt-amperes and volt-amperes. The use of complex numbers and vector diagrams is emphasized. The material covered in this course will serve as an excellent background for additional work in Electrical Engineering, such as, dynamo-electric machinery, power transmission and distribution, industrial electronic applications and communication engineering.

Total hours 72;—2 nights per week; 3 hours per night.



## A.C. AND D.C. MACHINES

**OBJECTIVE.** — This course is designed to provide instruction in Electrical Machines Characteristics and industrial application of these machines. The fundamental principles governing the performance of each type of electrical machine is emphasized and the part that each performs in determining the machine operating characteristics is indicated. After successfully completing this course, an individual should be qualified to work in the electrical departments of war industries.

**PREREQUISITE.** — High school graduation with two years of mathematics or its equivalent in practical experience and training. A complete knowledge of Electrical Circuits and Magnetic Circuit Characteristics is essential and employment in a war industry or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — This course material covers the study of machine magneto-motive forces, transformers, A.C. generators, D.C. generators, A.C. motors, D.C. motors, parallel operation of alternators, parallel operation of D.C. generators, machine efficiency and losses, and industrial applications. In studying the various machines the factors influencing their characteristics are emphasized and how these characteristics determine the industrial application of the machines.

Total hours 80;—2 nights per week;  $2\frac{1}{2}$  hours per night.



# **INDUSTRIAL ELECTRICAL MEASURING AND CONTROL INSTRUMENTS**

**OBJECTIVE.**—To provide engineers, instrument technicians and others using instruments in war industries with instruction and information on the several types of electrical measuring and control instruments. Individuals having a knowledge of the subject material included in the course will be qualified to solve many practical problems associated with the use of instruments in industry.

**PREREQUISITE.**—High school graduation with at least two years of mathematics or its equivalent in experience and training. A working knowledge of the material covered in Elements of Electrical Engineering or its equivalent is essential. A knowledge of Electrical Circuits is desirable and some knowledge of A.C. and D.C. Machines would be of value. The student must be employed in war industries where this training is needed.

**COURSE CONTENT.**—Subjects covered are the design, construction, operation and applications of electrical measuring and control instruments, including D.C. and A.C. indicating instruments, bridges, potentiometers, power and other measurements, instrument transformers, recording and integrating meters and automatic control apparatus, calibration methods and instrument maintenance. The course will supply a working knowledge of the important factors involved in the selection and use of electrical instruments for many industrial measurement and control applications.

Total hours 48;—2 nights per week; 2 hours per night.



# PRINCIPLES OF COMMUNICATION ENGINEERING

**OBJECTIVE.** — This course has been designed to aid men and women who desire to extend their present knowledge in the field of communication engineering. This course is in a specialized field of engineering with definite emphasis on the electrical phase. The content of the material has been chosen for those individuals who are now employed in industries which are engaged in the production of equipment and supplies for the war effort. After completing this course, the individual should have a working understanding of communication principles and should be qualified to be of great assistance in maintaining and installing communication equipment in the war industries.

**PREREQUISITE.** — High school graduation with two years of mathematics or its equivalent in experience and training. A working knowledge of the course material of Elements of Electrical Engineering or its equivalent is essential. Employment in war work where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — The main topics in the course outline include transmission theory, networks, filters, inductive loaded circuits, electronic application in wire communications and wireless communication.

Total hours 72;—2 nights per week; 3 hours per night.





# COMMUNICATION ENGINEERING

**OBJECTIVE.** — This course has been designed to aid men and women who desire to extend their present knowledge in the field of communication engineering. This course is in a specialized field of engineering with definite emphasis on the electrical phase. The content of the material has been chosen for those individuals who are now employed in industries which are engaged in the production of equipment and supplies for the war effort. After completing this course, the individual should have a working understanding of communication principles and should be qualified to be of great assistance in directing the installation of communication equipment in war industries.

**PREREQUISITE.** — High school graduation with two years of mathematics or its equivalent in experience and training. A working knowledge of the course material of Principles of Communication Engineering is essential. Employment in war work where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — This course is a continuation of the course, "Principles of Communication Engineering." It covers special circuit problems in wire communication, interference, wireless circuits, high frequency, etc.

Total hours 72;—2 nights per week; 3 hours per night.



# FUNDAMENTALS OF INDUSTRIAL ELECTRONICS

**OBJECTIVE.** — To train men and women in the basic principles of electron theory, practice through study and the application of fundamental electrical circuits and thereby qualify one to enter advanced courses in Industrial Electronics.

**PREREQUISITE.** — High school graduation with at least two years of high school mathematics or its equivalent in training and experience, employment in war work for which this training is needed or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — Fundamentals of the mathematics necessary to solve simple electrical circuits will be reviewed. The characteristics of electrical circuits including thorough training in Ohm's law and Kirchoff's law, Trigonometry and vectors will be given and used in connection with the study of A.C. circuits and their operation. There will be a comprehensive study of electric meters and electric circuit components in both D.C. and A.C. circuits. In addition to classroom discussion, there will be laboratory classes in which the student will study circuits under actual operating conditions. Total hours 72;—2 nights per week; 3 hours per night.



# INDUSTRIAL ELECTRON TUBES

**OBJECTIVE.** — To provide training in the fundamentals of electron tubes and their characteristics for those interested in further study in radio or industrial applications of vacuum tubes. It will qualify men and women for advanced radio or electrical engineering courses, and certain positions in industry requiring a practical and theoretical knowledge of electronic devices.

**PREREQUISITE.** — High school graduation with two years of mathematics or its equivalent in experience and practice. A working knowledge of Elements of Electrical Engineering or its equivalent is essential, and employment in war work where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — This course will treat the fundamentals underlying the operation of electronic devices and certain applications of these devices. Electron theory will be reviewed and tube emitters will be studied. The student will be thoroughly trained in the characteristics and uses of diodes, triodes, and multielement tubes, both high vacuum and gas filled, special purpose tubes such as cathode ray, electron microscope, and photoelectric cells. Laboratory experiments will be conducted during the course at which time actual data on tubes in operation will be recorded and analyzed to show their performance.

Total hours 72;—2 nights per week; 3 hours per night.



# **INDUSTRIAL ELECTRONIC CONTROL DEVICES I**

**OBJECTIVE.**—To provide training in a specialized phase of Electrical Engineering for men and women who are now employed in industries engaged in the production of equipment and supplies for the war effort. This course has been designed to aid those men and women who desire to extend their present knowledge of electron tube application in the industrial field. After completing this course, the individual should have a better understanding of electron tube devices and should be qualified to maintain and operate electronic devices used in industrial production processes.

**PREREQUISITE.**—High school graduation with two years of mathematics or its equivalent in experience and training. A working knowledge of the course material "Industrial Electron Tubes" is essential, and employment in war work for which this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—The material presented in this course will give a working knowledge of application of electronic devices to industrial problems. The course consists of an analysis of many industrial applications and how the various results are obtained. A study of amplifiers as applied to these devices is made.

Total hours 72;—2 nights per week; 3 hours per night.





# INDUSTRIAL ELECTRONIC CONTROL DEVICES II

**OBJECTIVE.** — To provide training in a specialized phase of Electrical Engineering for men and women who are now employed in industries engaged in the production of equipment and supplies for the war effort. This course has been designed to aid those men and women who desire to extend their present knowledge of electron tube application in the industrial field. After completing this course, the individual should have a better understanding of electron tube devices and should be qualified to maintain and operate electronic devices used in industrial production processes.

**PREREQUISITE.** — High school graduation or equivalent in appropriate experience. A working knowledge of "Industrial Electron Tubes," employment in war work where this training is needed or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — The material presented in this course will give a working knowledge of application of electronic devices to industrial problems. This course is a continuation of "Industrial Electronic Control Devices I." The course consists of an analysis of industrial applications and how the various results are obtained. Emphasis is on amplifier design for these special installations.

Total hours 72 ;—2 nights per week ; 3 hours per night.



# TRANSMISSION AND DISTRIBUTION OF ELECTRIC POWER—I

**OBJECTIVE.**—To provide training for men primarily interested in the transmission and distribution of electric power, both within industry, and the public utility field.

**PREREQUISITE.**—High school graduation with two years of mathematics, or equivalent in appropriate experience. A working knowledge of electrical circuits and employment in war industry where this training is needed or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—This course consists of lecture and discussion of the following topics: Electric Circuit Fundamentals; review of characteristics of electric circuit parameters. Magnetic Circuits; magnetization curves, permeability, circuit calculations, hysteresis and eddy current losses. Transformation; transformer fundamentals, equivalent circuits, vector diagrams, auto-transformers, transformation ratios. Dielectric Circuits; units, calculation of capacitance, electric fields around conductors. Branch Feeders; voltage drop, metering, losses main feeders, secondary feeders, protection, and coordination of fusing. Power Factor Correction; effects on voltage regulation and efficiency cost. Substation operation; location equipment, economics, operation, and automatic equipment.

Total hours 72;—2 nights per week; 3 hours per night.



# **TRANSMISSION AND DISTRIBUTION OF ELECTRIC POWER II**

**OBJECTIVE.**—To provide training for men primarily interested in the transmission and distribution of electric power, both within industry, and the public utility field.

**PREREQUISITE.**—High school graduation with two years of mathematics, or equivalent in appropriate experience. A working knowledge of electrical circuits and "Transmission and Distribution of Electrical Power I," and employment in war industry where this training is needed or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—This course consists of lecture and discussion of the following topics: transmission line constants; long line characteristics; short line characteristics; short circuit calculations; system stability; symmetrical components, and power diagrams.

Total hours 72;—2 nights per week; 3 hours per night.



# **INDUSTRIAL APPLICATIONS OF ELECTRIC MOTOR CONTROL EQUIPMENT**

**OBJECTIVE.**—To provide training in the phase of Electrical Engineering for men now employed in the war industries. This course has been designed to aid those men who desire to extend their present knowledge of Electric Circuit Theory and Application with direct emphasis on electric motors and their controls. The constant changing of peacetime industries to war production has placed an added burden on the electrical divisions of companies and it is hoped that with this additional training, the men may be able to relieve this burden.

**PREREQUISITE.**—High school graduation with two years of mathematics or equivalent in appropriate experience. A working knowledge of Electrical Circuit Characteristics and employment in war work where this training is needed or reasonable assurance of such employment on completion of the course.

**COURSE CONTENT.**—Definitions; operating characteristics; motors; selection of motor controls; overloads; multispeed motors; effects of variations in voltage; frequency ambient temperature on controls; connection diagrams; miscellaneous control circuits.

Total hours 72;—2 nights per week; 3 hours per night.





# **ELECTRIC MOTOR APPLICATIONS**

**OBJECTIVE.** — To provide training in a phase of Electrical Engineering for men now employed in war industries. This course has been prepared to aid those men who desire to extend their present knowledge of electric motor characteristics with direct emphasis on industrial uses.

**PREREQUISITE.** — High school graduation with two years of mathematics or equivalent in appropriate experience. A working knowledge of Electric Circuit phenomena and employment in war work where this training is needed or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — Definitions: torque equations; horse power calculations; direct current motor characteristics—shunt, series, compound; direct current motor selection; alternating current motor characteristics—synchronous, induction, single phase, series; alternating current motor selection.

Total hours 72;—2 nights per week; 3 hours per night.



# PERSONNEL SELECTION AND PLACEMENT

**OBJECTIVE.** — To provide specialized training in personnel selection and placement for men and women with a background in industrial personnel work.

**PREREQUISITE.** — High school graduation, completion of Personnel and Industrial Relations I course or its equivalent, and employment in personnel or supervisory work in a war industry or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — A study of the history, development and use of psychological tests; construction, administration, and interpretation of tests; statistical procedures as related to testing; special capacity tests; interviewing techniques and other employment procedures; the organization and establishment of scientific employment and placement procedures.

Total hours 64;—2 nights per week; 2 hours per night.



# **PERSONNEL AND INDUSTRIAL RELATIONS II**

**OBJECTIVE.** — To provide training in the field of Industrial Relations for employees of the personnel departments of those industries which are engaged in the war effort.

**PREREQUISITE.** — High school graduation or equivalent in appropriate experience, completion of Personnel and Industrial Relations I course and employment in war industry where this training is needed.

**COURSE CONTENT.** — The course will cover such subjects as the history and development of Industrial Relations, Physical Risks, Wages and Income, Labor Sources, Labor Relationships, Labor Organizations, Trade Unionism, The Personnel Department and Labor Legislation. Other subjects pertinent to Industrial Relations will be discussed. Total hours 64;—2 nights per week; 2 hours per night.



# PERSONNEL AND INDUSTRIAL RELATIONS

**OBJECTIVE.**—To provide training in Personnel and Industrial Relations for employees of personnel departments of war industries or for those now employed in a production supervisory capacity.

**PREREQUISITE.**—Two years of college or its equivalent in training and experience, employed in personnel work, or in a supervisory capacity in a war industry, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—Certain relationships that were formerly the sole province of the employer and his employees have now become mandatory. National laws in some cases prescribe specific procedure to be followed. New methods and practices have grown, and supervisors or workmen should know something of the methods used to select and train employees to be useful workmen and good citizens. The course will include the following subjects: Personnel Management; job analysis, specifications, and standardization; recruitment, selection, and placement; transfer, promotion, and dismissal; labor turnover, education and training of employees; and other subjects pertinent to industrial relations.

Total hours 64;—2 nights per week; 2 hours per night.





# INDUSTRIAL MANAGEMENT

**OBJECTIVE.**—To provide training for employees of war industries in the development and application of the principles of Scientific Management, designed to give a broad perspective of industrial operations as a background for further study in production work.

**PREREQUISITE.**—High school graduation or equivalent in industrial experience; preferably in planning, routing, and dispatching or related work and recommended by management.

**COURSE CONTENT.**—The subjects discussed include: organization of an industrial enterprise, plant location and layout, materials handling, simplification and standardization, motion and time study, industrial relations, methods of wage payment, inventory control and production control.

Total hours 64;—2 nights per week; 2 hours per night.



# **INDUSTRIAL SUPERVISION FOR PROSPECTIVE FOREMEN**

**OBJECTIVE.** — To provide basic training in the fundamental nature of industrial supervision for selected employees of industries now engaged in the production of essential material needed for the prosecution of the war. The course is designed so as to qualify those enrolled for positions of foremen, assistant foremen or other levels of supervisory responsibility. The subject matter treated in this course should be of particular interest to those who aspire to positions of leadership in the fields of production, inspection and staff.

**PREREQUISITE.** — High school graduation or its equivalent. Trainees to be employed in war industries and to be recommended by their firms to receive this training. (The equivalent to high school graduation in this case may be two or more years experience in industry in which the applicant has demonstrated promise of future leadership.)

**COURSE CONTENT.** — This course will include a study of industrial development and organization, responsibilities of supervision and lines of authority, cost control, job analysis, selection, allocation and training of workers. Special emphasis is laid on human factors and leadership development. Other subjects studied are merit rating, turnover, waste control, and labor relations.

Total hours 48 ;—2 nights per week ; 2 hours per night.



# ORGANIZATION AND TECHNIQUES OF INDUSTRIAL SUPERVISION

**OBJECTIVE.** — To provide training in the nature of upgrading for industrial supervisors at various levels of responsibility, but particularly for foremen and subforemen in the areas of production, inspection, safety and maintenance. The course is designed to improve supervisory techniques as they concern the human factor. A better understanding of the relations of the foreman to both management and workers is the primary aim of the course.

**PREREQUISITE.** — High school education or equivalent and employment in supervisory capacity of war industry and recommended by management.

**COURSE CONTENT.** — The course will consist of group discussions of the important phases of industrial supervision. The subject matter includes such topics as the organization of industrial plants, interpreting company policies, the supervisor's place in the industrial structure, departmental planning, job evaluation, waste control, production and measuring quality, selecting, placing and training employees, transfers, promotions, and discharges. Special emphasis is laid upon the human element in supervision in such subjects as attitudes and morale, grievances and discipline, safety and supervision, qualities of leadership, and cooperation.

Total hours 56;—2 nights per week; 2 hours per night.



# PRODUCTION ENGINEERING

**OBJECTIVE.**—Provides training for those men now engaged in the production of materials and equipment in war industries, such as: production and assistant production supervisors; production planning clerks; junior industrial engineers; and assistant time study engineers.

**PREREQUISITE.**—High school graduation with some knowledge of production methods or its equivalent, preferably those employed in an industrial engineering planning department of a war industry or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—A study of manufacturing methods, materials handling, storing, purchasing, and factory time and motion study rates, cost controls and personnel coordination to provide a background of knowledge and information that deals with the use of men, methods, material, and money in modern industry.

The economic and social effects of inventions, the growth of industrial enterprises, and specialization of manufacturing establishments are included so that the student may understand how modern industry has affected the habits and standards of living of our working people.

Total hours 72;—2 nights per week; 3 hours per night.





# **PRODUCTION CONTROL**

## **(In Service Only)**

**OBJECTIVE.** — To provide specialized training in production planning and material control.

**PREREQUISITE.** — High school graduation or equivalent, completion of ESMWT course in production engineering or equivalent in appropriate experience and employment in production control departments or material control departments of war industries.

**COURSE CONTENT.** — Study of production and material control methods such as routing, scheduling, dispatching, estimating production rates; also, development of forms, charts and control boards for case problems.

Total hours 64;—2 nights per week; 2 hours per night.



# **JOB ANALYSIS AND EVALUATION**

**OBJECTIVE.**—To provide training to supervisors and employees with the methods used in industry to set wages and salary.

**PREREQUISITE.**—High school graduation with one year of mathematics or its equivalent in practical industrial experience and recommendation of company to take this course.

**COURSE CONTENT.**—This course is planned for executives and workers seeking a practical method for the determination of equitable wage and salary rates. Collective bargaining requirements of today make it necessary that industry be able to justify its scale of wages and salaries. Therefore, some systematic plan must be used to determine wage and salary rates.

Total hours 48;—2 nights per week; 2 hours per night.



## TRAFFIC MANAGEMENT II

**OBJECTIVE.** — To give the student a working knowledge of how to place, execute and administer work connected with rate structures for freight and other transportation services.

**PREREQUISITE.** — High school graduation, plus satisfactory experience in traffic or related fields, to increase the efficiency of trainees in serving and managing traffic departments.

**COURSE CONTENT.** — The course covers rate structures for Western, Southern, Eastern and Southeastern rail lines. Also miscellaneous rate structures are included, such as, export, import, Railway Express, Airway Express, motor freight and freight forwarding rates.

Total hours 48;—2 nights per week; 2 hours per night.



## **TRAFFIC MANAGEMENT III**

**OBJECTIVE.** — To provide training for Traffic Managers and Assistants who plan, administer, and execute work connected with rate structures for freight and other transportation services.

**PREREQUISITE.** — High school graduation plus satisfactory experience in traffic, a working knowledge of Traffic Management I and II.

**COURSE CONTENT.** — The principal subjects covered by this course consist of: The checking of rate structures from tariffs in truck line territories; the switching, reconsigning, and elements of motor freight tariffs; review of export, import, coastwise, and airways express as applied to motor freight and freight forwarding rates.

Total hours 48;—2 nights per week; 2 hours per night.





# TIME AND MOTION STUDY

**OBJECTIVE.**—To provide training in rate setting and time study for men to serve in defense industries.

**PREREQUISITE.**—High school graduates with considerable experience in the field of time and motion study or its equivalent. Employed in war industry where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—The modern time study man should have a fundamental knowledge of shop processes and principles involved in interchangeable manufacture. As a consequence the student will, therefore, be given instruction covering the aforementioned subject matter either before or during the time he is being drilled in time and motion study methods.

Instruction will be given in the taking of actual time studies, the application of micro-motion analysis and the setting of standard production rates. Some study of incentive wage systems will also be included.

Later, the student will be given practice in setting rates for various operations including synthetic or compiled cycle time and the use of time study formulae and standard time charts. Included also will be the use of time study allowances, personal allowances, and the interpretation of time and motion study data.

Total hours 72;—2 nights per week; 3 hours per night.



# **TIME AND MOTION STUDY FOR SUPERVISORS (In Service)**

**OBJECTIVE.**—To train Production Supervisors in the use of Time and Motion Study techniques to the point where they may effectively put them to use in a concern at the supervisory level.

**PREREQUISITE.**—High school graduation with two years of mathematics or equivalent in industrial experience and employment in a war industry in a supervisory capacity.

**COURSE CONTENT.**—A general view of the techniques of Time and Motion Study and their interrelationships is given: discussion of process charts, operation charts, micromotion study, therblig check lists, motion economy, and stop watch time study. These discussions include the technical details and emphasize the methods of application, and the personnel problems involved.

Total hours 50 ;—2 nights per week ; 2 hours per night.



# **ADVANCED TIME AND MOTION STUDY (In Service Only)**

**OBJECTIVE.** — Trainees will receive instruction regarding the techniques of Motion and Time Study which facilitate increasing the productivity of war industries.

**PREREQUISITE.** — Two years of college training and industrial experience in production work, or high school education including two years of mathematics and industrial experience as Supervisor of Production.

**COURSE CONTENT.** — A study of advanced methods and techniques in method analysis. The study of occupational rating, wage incentives, and work simplification will be emphasized.

Total hours 72;—1 night per week; 2 hours per night.



# QUALIFYING COURSE IN MATHEMATICS FOR ENGINEERS

**OBJECTIVE.** — To provide training in mathematics for those whose high school training has been inadequate in this respect. This is a qualifying course intended to prepare them for registration in other E.S.M.W.T. courses in engineering subjects where the prerequisite is two years of high school mathematics, or its equivalent. The course is concerned mainly with manipulative skills in algebra, since the applications are included in other courses. Geometry is treated from an intuitive point of view with little emphasis on formal proofs. A working knowledge of logarithms and trigonometry is emphasized through many problems in computation.

**PREREQUISITE.** — High school graduation with two years of mathematics and employment in war work where this training is needed.

**COURSE CONTENT.** — The course consists of 20 hours of algebra, including a study of the four fundamental operations, solution of simple equations, ratio and proportion, simultaneous linear equations, graphs, and quadratic equations.

Ten hours of Intuitive Geometry, including angles, and triangles, similar and congruent triangles, parallel lines, quadrilaterals, circles, and simple solids.

Eighteen hours of Trigonometry, including definitions of the trigonometric functions, simple relations between the functions, solution of right triangles, logarithms and their application to the solution of triangles.

Total hours 48;—2 nights per week; 2 hours per night.





# ENGINEERING MATHEMATICS

## (In Service)

**OBJECTIVE.**—To provide training for employees now engaged in war industries whose proficiency and usefulness to the industry will be enhanced by a better knowledge of mathematics. The course will also serve as a basis for further study of mathematics and prepare the student for work in applied fields. This course will provide the mathematical background necessary in the study of Elements of Electrical Engineering, Electrical Circuit Theory, Fundamentals of Radio Theory, Engineering Chemistry, Map Drafting, A.C. and D.C. Machines, Elementary Tool Design, and Theoretical and Applied Mechanics.

**PREREQUISITE.**—Graduation from an approved high school or its equivalent, including two years of high school mathematics or completion of the qualifying course in Mathematics for Engineers, and employment in war industry where this training is needed or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—This course begins with drill and a review of the fundamental operations of arithmetic and algebra. It includes the elements of plane geometry with applications to engineering. Other topics are: Theory and application of exponents and radicals, linear equations in one or more unknowns, systems of linear equations, quadratic equations, variation, functions and their graphs, graphical solution of problems, theory and use of logarithms. The fundamental aspects of trigonometry are included and many applications are made to engineering problems. These special problems include applications to physics and mechanics, electrical theory, shop problems, and applications of vector theory.

Total hours 72;—2 nights per week; 3 hours per night.



## **ADVANCED ENGINEERING MATHEMATICS (In Service)**

**OBJECTIVE.** — To provide additional training in mathematics for those employees who wish to build an adequate mathematical background to enable them to continue advanced study in specialized fields of engineering.

**PREREQUISITE.** — One year Engineering College mathematics or its equivalent and employment in war work for which this training is needed.

**COURSE CONTENT.** — An intensive study of Analytical Geometry and Calculus, with special emphasis on the application of differentiation and integration to engineering problems.

Total hours 64;—2 hours per night; 2 nights per week.



# ANALYSIS AND INTERPRETATION OF EXPERIMENTAL DATA

**OBJECTIVE.** — This course will cover some of the established methods used in unraveling an accumulation of data and interpreting these data in the form of an empirical equation if possible. Occasionally a problem contains too many uncontrolled variables, and cannot be reduced to an empirical equation. In such cases valuable information can frequently be obtained from the data by the application of statistical methods.

**PREREQUISITE.** — One year of college mathematics including a working knowledge of physics or satisfactory completion of the course "Engineering Mathematics" and a working knowledge of physics.

**COURSE CONTENT.** — There are five subdivisions which will be presented and studied. They are namely: (1) Dimensional Analysis, (2) Mathematical Analysis of Errors, (3) Graphical Presentation of Data, (4) Empirical Equations, and (5) Statistical Methods.

Total hours 72;—2 nights per week; 3 hours per night.



# METALLURGY OF IRON AND STEEL

**OBJECTIVE.**—To provide instruction in a phase of Metallurgical Engineering for men now employed in war industries where the making, shaping, and treating of iron and steel is concerned in the products produced. The course is especially designed to give a comprehensive knowledge of the modern methods of producing iron and steel, the varieties of iron and steel manufactured, and the methods of shaping steels to shapes for final use by the consumer.

**PREREQUISITE.**—High school graduation with one year of chemistry, physics, and mathematics or one year of college chemistry and physics, and employment in a war industry where this training is needed.

**COURSE CONTENT.**—The material presented in the course will cover metallurgical fuels and refractories; iron ores; manufacture of cast, malleable, and wrought irons; manufacture of acid and basic Bessemer steels; manufacture of acid and basic open hearth steels; manufacture of electric furnace steels; and so far as time will permit the shaping of steel ingots into finished products.

Total hours 60;—2 nights per week; 2 hours per night.





# HEAT TREATMENT OF PLAIN CARBON STEELS

**OBJECTIVE.**—To provide instruction in a phase of Metallurgical Engineering for men and women now employed in war industries where the heat treatment of steel plays an important role in the manufacture of metal products. The course is especially designed to give a comprehensive knowledge of the methods used in heat treating plain carbon steels, the effect of heat treating operations upon the physical properties produced, and a correlation of the physical properties with the micro structure. This course presents the fundamental and basic material for the course in heat treatment of alloy steels.

**PREREQUISITE.**—High school graduation with one year each of chemistry, mathematics and physics. A working knowledge of Metallurgy of Iron and Steel, and employment in war industry where this training is needed or reasonable assurance of such employment on completion of the course.

**COURSE CONTENT.**—The material in this course will cover stable and metastable equilibrium of the iron-carbon diagram; pure iron; iron carbide; impurities in iron and steel; full annealing, spheroidizing, normalizing, quenching and tempering of carbon steels; correlation of the microstructures produced by heat treatment with the physical properties of carbon steels; nitriding, cyaniding, surface hardening, hard surfacing, and carburizing treatments; types of furnaces used; and control of furnace atmospheres.

Total hours 60;—2 nights per week; 2 hours per night.



# HEAT TREATMENT OF ALLOY STEELS

**OBJECTIVE.**—To provide instruction in the methods of heat treating alloy steels; the individual and cumulative effects of alloying elements when added to steels; special purpose and alloy steels; and the physical properties and indicated uses of alloy steels.

**PREREQUISITE.**—High school graduation or its equivalent, including courses in chemistry and physics. Completion of the course "Heat Treatment of Plain Carbon Steels," or its equivalent and employment in war industries where this training is needed or reasonable assurance of such employment on completion of the course.

**COURSE CONTENT.**—The individual effects of phosphorous, sulphur, lead, manganese, silicon, copper, nickel, chromium, aluminum, titanium, zirconium, vanadium, molybdenum, and tungsten when added to steels; high yield strength low alloy steels; complex alloy steels based on ferritic strengthening elements; complex alloy steels based on carbide formers; alloy steels for nitriding and cyaniding; alloy steels for high- and low-temperature service; austenitic steels; high speed steels; and permanent magnet steels.

Total hours 60;—2 nights per week; 2 hours per night.



# HYDRAULICS AND HYDRAULIC MACHINES

**OBJECTIVE.** — This course is planned to give students a basic knowledge of the fundamental principles of hydraulics and hydraulic machines as they apply to pump manufacturing industries.

**PREREQUISITE.** — High school graduation with two years of mathematics and physics, or its equivalent in practical industrial experience. Additional training in advanced mathematics and mechanics is preferable, and employment in war industries where this training is needed.

**COURSE CONTENT.** — Thorough review of mathematics and mechanics (statics) including simple algebraic equations, trigonometric functions and the solution of simple force systems relative to the analysis and understanding of the fundamental concepts of hydraulics and hydraulic machines. The physical properties of fluids and the fundamental concepts of fluids as static bodies will be thoroughly studied. A comprehensive study is made of the laws governing the flow of fluids in pipes, the relation of velocity and pressures, the effects of viscosity upon the flow, and the loss of energy caused by various fittings and valves.

After the student has mastered the fundamental principles of hydraulics, the operation of machines, such as complicated valves, pumps and motors, is studied. The apparatus is then actually handled by the student.

Total hours 72;—2 nights per week; 3 hours per night.



# **RESISTANCE OF MATERIALS**

## **(INDUSTRIAL)**

**OBJECTIVE.**— This course is planned to give the student the basic principles needed to design structural members and machine parts. Also a knowledge concerning the physical properties and physical testing of engineering materials.

**PREREQUISITE.**— High school graduation with two years of mathematics including algebra and trigonometry and completion of the course in Theoretical and Applied Mechanics or its equivalent.

**COURSE CONTENT.**— In this course a study is made of the stresses and strains produced in structural members by various types of loads such as tension, compression, twisting and bending. Also, the stresses in thin-walled cylinders and spheres, riveted joints and welded joints are analyzed. A study is also made of the various types of columns and the formulas used in their design. Modes of failure of various engineering materials and allowable working stresses for these materials are discussed.

Total hours 72;—2 nights per week; 3 hours per night.





# THEORETICAL AND APPLIED MECHANICS

**OBJECTIVE.** — This course is planned to give students a knowledge of the fundamental principles of statistics. It is a beginning course for those who wish to prepare themselves for positions involving knowledge of the design of machines and structural parts.

**PREREQUISITE.** — One year in a college of engineering or its equivalent. High school graduates with some knowledge of mechanical drawing and a satisfactory knowledge of algebra and trigonometry may be admitted on approval of instructor.

**COURSE CONTENT.** — In order to design machines, buildings, bridges, or other structures it is necessary to estimate the loads which must be supported and then to determine the forces which act upon the individual parts which comprise the structure or machine so that the proper size and shape of each part may be calculated. This course discusses the principles of engineering mechanics and the methods of applying these principles in a variety of cases. Some of the topics discussed are: Resultants of force systems of various types, equilibrium, stresses in trusses for buildings, bridges, frames, and cranes, friction and centroids.

Total hours 64;—2 nights per week; 3 hours per night.



# ENGINEERING ANALYSIS I

**OBJECTIVE.** — To provide immediately useful training for engineers, draftsmen, and foremen engaged in important war work in the mechanical and structural phases of the transportation industry. It is not intended as a small part of a rounded program of academic education, but is designed to help increase the efficiency and productivity of those engaged in specific war work. The course draws together the student's knowledge of mathematics, statics, mechanics, and strength of materials, and illustrates their application in the logical analysis of problems occurring daily in his occupation.

**PREREQUISITE.** — High school graduation with high school mathematics, including trigonometry, or one or more years of experience in the mechanical and structural side of the transportation industry, and employment in war industry where this training is needed.

**COURSE CONTENT.** — Fundamental concepts of machines; movement and force, energy and work; conservation and transformation; origins of force; hydraulics of machines, kinetics, and kinetic energy; general consideration of strength of machine members.

Total hours 72;—2 nights per week; 3 hours per night.



## ENGINEERING ANALYSIS II

**OBJECTIVE.** — A continuation of Engineering Analysis I. The course continues and extends the discussion of logical analysis of everyday problems occurring in the student's occupation.

**PREREQUISITE.** — High school graduation with mathematics, including trigonometry and one or more years of experience in the mechanical and structural side of the transportation industry and completion of Engineering Analysis I. Employment in war work for which this training is needed.

**COURSE CONTENT.** — Fundamental properties of engineering materials and their relation to stress, strain, and elasticity; tension, compression, shear, and combined stresses; flexure; columns; eccentric loads, buckling; torsion, shafts, keys, splines, concentration of stress; cylinders, plates, rollers, and gears; work and resilience, dynamic loads, repeated loads, and safety factors.

Total hours 72;—2 nights per week; 3 hours per night.



# **RADIO TECHNOLOGY I**

## **(Fundamentals of Radio Circuit Analysis)**

**OBJECTIVE.**—To provide training for those men and women who desire to learn the basic principles of radio theory and practice through study and application of fundamentals of radio circuits, and thereby become qualified to enter advanced radio courses.

**PREREQUISITE.**—High school graduation with two years of mathematics and one year of physics or equivalent, and employment in war work for which this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**—Thorough review of elementary mathematics including solution of simple equations relative to analysis of fundamental radio circuits. The fundamental concepts and relations necessary for thorough understanding of direct current circuits will be developed. The characteristics of inductance, capacitance and resistance will be given full treatment at both low and high frequencies. These fundamentals will be applied to resonant circuits, transformers and filter circuits. There will be a comprehensive study of electric meters and their uses in both direct and alternating current circuits. In addition to classroom discussions, there will be laboratory classes in which the student will actually construct many of the basic radio circuits and make complete tests on these assemblies.

Total hours 72 ;—2 nights per week ; 3 hours per night.





## RADIO TECHNOLOGY II

**OBJECTIVE.** — The material presented in this course will train the student in the operation, maintenance and construction of radio transmitters and receivers and through this training he may qualify as laboratory assistant, radio operator or radio maintenance personnel.

**PREREQUISITE.** — High school graduation including two years of mathematics, one year of physics and completion of Radio Technology I or equivalent. Employment in war work where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — Various types of oscillators, modulators, radio frequency amplifiers are treated in connection with radio transmitters. The student will be given training in radio receiver circuits, alignment, repair and re-design. The characteristics of the components used in this equipment are also studied. Laboratory experiments are provided to give the student opportunity to construct and operate the various types of circuits being studied. Wide reading in the adaption of circuits to practical operating situations are provided. Further study of vacuum tube characteristics in connection with these circuits will also be pursued. Total hours 72 ;—2 nights per week ; 3 hours per night.



# **SAFETY ENGINEERING**

## **(Basic)**

**OBJECTIVE.** — This course is designed to promote safety and conserve manpower in our wartime industries by the training of men and women for leadership in safety programs.

**PREREQUISITE.** — High school graduation or equivalent in industrial supervisory experience. Leadership characteristics and employment in a war industry in a supervisory capacity are essential.

**COURSE CONTENT.** — This course includes such safety subjects as: Safety, a problem of management; duties of the safety director; safety committees; correct operating methods and hazards involved; use of safeguards and protective equipment; good housekeeping; industrial hygiene; industrial psychology; and other subjects pertinent to safety. This minimum program of necessity is generally worded and calls for less than average safety work. Therefore it is not anticipated that there will be conflict with other existing programs or requirements. It is expected that these minimum requirements will be used as a basis on which a more complete program, suited to the size and needs of the individual establishment, will be set up.

Total hours 96;—2 nights per week ; 3 hours per night.



## **SAFETY ENGINEERING B**

### **(Advanced)**

**OBJECTIVE.**— This course is designed as a follow-up of the basic safety engineering course, dealing principally with the theory of safety psychology and its effect in the establishment and maintenance of a good operating safety program. Trainees will be prepared to organize and direct safety organizations in war industry by strengthening these safety organizations within industry. Lost time accidents can and will be reduced.

**PREREQUISITE.**— High school graduation or equivalent, completion of basic course in safety and employment in a supervisory capacity of an essential industry with responsibility for safety and recommendation by management.

**COURSE CONTENT.**— This course is planned for the advanced training of industrial safety engineering. It has to do with the engineer on the job—the utilization of the subject matter of the various courses to prepare the individual to take over supervisory work in Safety Engineering. With this course and the basic safety course as a background, the employee should and will be in a position to further the cause of accident prevention, which is so vital to our war industries.

Total hours 48;—2 nights per week; 2 hours per night.



# ESSENTIALS OF ENGINEERING

## (In Service)

**OBJECTIVE.**— This course is designed primarily to train people, who are unfamiliar with the shop, to perform satisfactorily as inspectors. The content may be adjusted to suit the abilities and needs of the industry.

**PREREQUISITE.**— High school graduation with two years of mathematics or equivalent in industrial production. Employment in war industry where this training is needed is essential.

**COURSE CONTENT.**— The course contains three main subjects, namely: Mathematics, Drafting and Inspection. The course material is so arranged to give the students a practical background in mathematics and drafting. This background then may be applied to the actual use of gages and inspection instruments, theory of gaging policy and quality control.

Total hours 72;—2 nights per week; 3 hours per night.





# FOUNDATIONS OF ENGINEERING A

**OBJECTIVE.** — To provide the training in basic physical science and mathematics needed in common engineering practices. The course is planned for those who wish to acquire the fundamentals of an engineering education and might well be completed before more advanced and specialized courses are undertaken. The course should prove valuable to anyone desiring to improve his understanding in the physical principles used in dealing with special production problems arising in war industries.

**PREREQUISITE.** — High school graduation with one year of mathematics or equivalent in appropriate experience and employment in war work where this training is needed or reasonable assurance of such employment on completion of the course.

**COURSE CONTENT.** — Mathematics covering review of arithmetical processes, algebra, geometry and some introduction into trigonometry will be offered. Study of mathematics will combine with the material in physical science and such engineering applications as are appropriate. Most of the physical illustrations will be drawn from mechanics, properties of materials and heat. Special instruction in the use of the slide rule, logarithms, elasticity, flow problems, heat and acoustic insulation, illumination, thermal stress, heat engines, etc., may be provided for groups who are interested.

Total hours 96;—2 nights per week; 3 hours per night.



# ENGINEERING PHYSICS

**OBJECTIVE.**— This course is designed to provide the basic scientific training essential to the understanding of modern engineering practice. Students who have completed this course will be prepared to make rapid progress in such fields as mechanics, hydraulics, heat engineering, air conditioning, physical testing, electrical engineering acoustics, aerodynamics, engineering management, etc.

**PREREQUISITE.**— High school graduation with two years of mathematics or equivalent and employment in war work where this training is needed.

**COURSE CONTENT.**— The basic concepts of mechanics, heat, meteorology, acoustics, illumination and electrical circuits will be covered. Directed study from a standard text will be required. The work will be supplemented by recitations, demonstrations, discussion, laboratory work with simple instruments, problems, and reference work. Training will be given in the laws and scientific principles involved in the study of the design of buildings and machines, the determination of the properties of materials; the development and use of heat engines, batteries, generators, and motors; the problems of heat insulation, air conditioning, sound proofing, lighting, optical instruments, and high temperature measurement.

Total hours 96;—2 nights per week; 3 hours per night.



# ELEMENTARY TOOL DESIGN

**OBJECTIVE.** — Provides training for the design of jigs, fixtures, and special tools as applied in our war industries.

**PREREQUISITE.** — High school graduation with two years of mathematics or equivalent education and employed in war work where this training is needed, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — This course is planned to teach the methods used in interchangeable manufacturing and the theory underlying the design of jigs, fixtures, and dies used in modern production. The course will include the technique of dimensioning drawings and standardization as it affects design and production. Materials used for the construction of jigs, dies, and fixtures will be studied so that the student may learn to select the proper material for the various parts. It is necessary to heat treat certain parts of jigs and dies so that it will be necessary to teach some of the theory of heat treatment.

Machine shop processes will be studied for a background, such as turning and boring, drilling, milling, gear cutting, and grinding. A study of the use of gages and some theory of measurement and the actual design of simple jigs, fixtures, and dies.

Total hours 72;—2 nights per week; 3 hours per night.



# JIG, FIXTURE, AND DIE DESIGN

**OBJECTIVE.**— To provide training in the design of jigs, fixtures and dies; special tools and gages necessary to our war industries.

**PREREQUISITE.**— High school graduation with two years of mathematics or equivalent in appropriate experience, and a working knowledge of course in Elementary Tool Design. Employed in war industry where this training is needed or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.**— A study of the manufacturing processes, and modern die and punch design. Hardening and tempering of dies and punches. A study of shell production and the necessary tools for their manufacture. Application of mathematics required for an understanding and working knowledge of shop problems that confront the tool designer, the toolmaker, and inspectors.

Total hours 72;—2 nights per week; 3 hours per night.





# **PUNCH AND DIE DESIGN**

**OBJECTIVE.** — To provide training in the design of dies and punches as applied in war industry.

**PREREQUISITE.** — High school graduation and a working knowledge of Elementary Tool Design. Employed in war industry where this training is needed or reasonable assurance of such employment on completion of the course.

**COURSE CONTENT.** — A study of the design of dies and punches with considerable attention to the application of mathematics.

Total hours 72;—1 night per week; 2 hours per night.



# PLASTICS ENGINEERING I

**OBJECTIVE.** — To provide training in the fundamentals of engineering as applied to plastics and the plastics industry, and to provide a knowledge of the properties of plastics which must be considered in selecting plastics for uses in industry.

**PREREQUISITE.** — High school graduation with one year of mathematics and chemistry or equivalent in appropriate industrial experience and employment in the plastics industry, or reasonable assurance of such employment upon completion of the course.

**COURSE CONTENT.** — The course will include the study of the place of plastics in the industrial field; a survey of the common plastics, such as cellulose acetate, "Lucite," etc.; source of raw material; methods of manufacture; qualitative chemical, electrical, optical, mechanical, thermal properties; typical applications and limitations; methods of test, with particular emphasis on the interpretation of test results, and the precautions necessary to obtain reliable test results; known properties of the more important plastics; the effect of different factors which may alter the strength and other properties of plastics.

Total hours 32;—2 nights per week; 2 hours per night.



## PLASTICS ENGINEERING II

**OBJECTIVE.** — To provide training in present methods of manufacture of moldings, including the design of molds, laminates and fabricated parts made of plastics, and to provide a knowledge of the properties and heat-treatment of metals as related to the design of molds and hobs.

**PREREQUISITE.** — High school graduation with one year of mathematics and chemistry, or equivalent in appropriate industrial experience, and completion of Plastics Engineering I.

**COURSE CONTENT.**— The course will include a study of the structure, heat-treatment, and strength of steels as related to the design and fabrication of mold and dies; molding processes and design of molds; laminating methods; fabricating processes; and machines and equipment for molding and laminating. The effect of molding and laminating technique on the resulting properties of the plastic will be considered in relation to the material covered in Plastics Engineering I.

Total hours 48;—2 nights per week; 2 hours per night.



# **DIESEL ENGINE THEORY**

**OBJECTIVE.** — To provide training for those persons now employed in operation and maintenance of Diesel engines, also laboratory assistants in industries using or manufacturing Diesel equipment.

**PREREQUISITE.** — High school graduation or its equivalent in appropriate experience and practical industrial experience with Diesel engines.

**COURSE CONTENT.** — The course will cover the history and development of the Diesel engine, the types used, combustion chambers, nozzles, fuels, lubrication, cooling, construction of detailed parts, governors, testing, engine characteristics, theoretical background and use of instruments for checking performance.

Total hours 64 ;—2 nights per week ; 2 hours per night.





# COMBUSTION AND UTILIZATION OF COAL

**OBJECTIVE.**—To provide instruction in the principles of combustion and utilization of coal. This course has been especially designed to aid coal salesmen, stoker men, engineering, building owners, plant operators, and coal mine operators in understanding the operation of efficient and modern coal burning equipment, methods of securing efficient combustion of coal, and the comparison of other fuels with coal for producing heat and power.

**PREREQUISITE.**—High school graduation with one year each of chemistry, physics, and mathematics or equivalent in appropriate experience.

**COURSE CONTENT.**—The material presented in this course will offer a fundamental knowledge of the combustion of coal; design and operation of coal burning equipment; abatement of the smoke nuisance; equipment for smokeless combustion of coals; coke and its manufacture; problems in marketing coal; generation of steam and power; combustion instruments; stokers and stoker coals; and a comparison of coals with other fuels.

Total hours 48;—2 nights per week; 2 hours per night.



# COAL PREPARATION

**OBJECTIVE.** — To provide training in a phase of Mineral Dressing for men now employed in the coal industry. The course has been designed to give a fundamental knowledge and understanding of modern methods of preparing coal for the market, the principles of coal preparation plant operation, and the theory of modern methods of treating coal.

**PREREQUISITE.** — Graduation from an approved high school or its equivalent, including one year of chemistry, physics, and mathematics. In special cases, men with extended experience in the operation of coal preparation plants may be enrolled in the course without graduation from high school.

**COURSE CONTENT.** — Crushing and screening of coal; wet methods of cleaning coal; jig washers; upward current washers, trough washers; wet concentrating tables, dense media separators; dewatering wet coals; treatment of washery waters; air and pneumatic cleaners; applications of froth flotation to coal preparation; accessory apparatus in coal preparation plants; laboratory control; and economics of coal preparation.

Total hours 48;—2 nights per week; 2 hours per night.



# WELDING ENGINEERING

**OBJECTIVE.** — To provide training for Junior Engineers, Designing Engineers and Electric Welders with the theory of Welding Engineering as applied to welding with specific regard to Fabrication.

**PREREQUISITE.** — High school graduation with one year of mathematics and physics or equivalent in appropriate experience in field of welding, fabrication and design of vital war materials.

**COURSE CONTENT.** — Welding Engineering is a review of welding processes in which particular stress is made of the metallurgical factors governing these processes. Also special emphasis is placed on weldability of steels and factors governing the techniques of welding low alloy steels, copper, aluminum, and nickel and their respective alloys. Standard qualification procedure and inspection of fusion welding will also be treated in detail.

Total hours 36;—1 night per week; 3 hours per night.



The Division of University Extension offers a program of extramural courses other than the program announced here. There are available, also, college credit courses taught by correspondence. The Division co-operates with the United States Armed Forces Institute, with correspondence courses for men and women in the Army, Navy, Marines, and Coast Guard. The Division has a lending library of educational motion pictures.

For information as to these services  
write to

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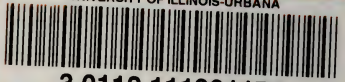








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